35. SEASONAL VARIATION IN CHEMICAL CONSTITUENTS OF SOME AQUATIC PLANTS[1]

The dependence of aquatic plants on the substratum for nutrients has been a matter of controversy though Pearsall (1920) and Misra (1938) propounded the absorption of nutrients by aquatics from the substratum. According to Welch (1935) the substratum provides only mechanical support and the aquatic plants derive nutrients from the surrounding water. The chemical analysis of a few aquatic plants were undertaken in order to understand the variation of chemical constituents during different stages of growth, flowering and fruiting. The water in which these plants were growing was also analysed periodically for its relationships to the aquatic plants.

Material and Methods

The samples of aquatic plants included roots, flowers, and fruits and care was taken to collect plants of the same age from different parts of the Doodhadhari Lake. No attempt was made to separate out plants from different depths.

The dry ashing technique was used throughout as recommended by Peach & Tracy (1956). Five grams of oven dry sample was taken in a Silica basin and the ash digested in hydrochloric acid was made to 250 ml in a volumetric flask. The residue is reported as silica and the solution was used for the determination of different elements.

The Kjeldahl method as recommended by Jackson (1958) was used for determination of total nitrogen, from 0·5 gm. of dried plant material.

The hydrochloric acid extract was used for the determination of calcium by titrimetry, magnesium by gravimetry and sodium and potassium separate by flame photometric methods.

Observations

Calcium : The concentration of calcium was found to show two peaks in most of the plants. Some plants showed a third peak also. The first peak was found in late rainy season and this continued till February. From February onwards a decline was found up to April. From April the concentration increased except in *Eichhornia*

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[1] Based on a part of the Thesis submitted for the Degree of Ph.D. to the R.S. University, Raipur.

crassipes and *Najas minor*. The fluctuation of calcium was found more or less related to the growth periods. In September most of the plants were mature and showed maximum calcium. In February regeneration of plants probably brought about a decline in calcium.

Magnesium : *Eichhornia crassipes*, *Pistia stratiotes* and *Ceratophyllum demersum* recorded maximum magnesium content in February. Except for *Hydrilla* a general decline in magnesium was recorded. Regeneration after February brings forth this decline as large amounts of magnesium are withdrawn for photosynthesis and other metabolic processes. Young shoots of *Najas* and *Trapa* were found to contain very little of magnesium as observed from February to July. *Trapa bispinosa*, and *Pistia stratiotes* showed maximum in September.

Potassium : *Eichhornia* and *Pistia* were found to contain maximum amounts of Potassium in July during the early growing period, but *Trapa* showed very little potassium from February to June during its early growth period. In *Ceratophyllum* two peaks for potassium were found. One in April and the other in September. Young plants of *Nymphaea cyanea* recorded very little potassium in the beginning in August but quite contrary to this *Nelumbo nucifera* was found to contain maximum during early period of growth in February.

Sodium : The seasonal variation of sodium in plants corresponds to that of potassium. The young offsets of *Pistia stratiotes* were found to contain maximum sodium in February and April. Two peaks for sodium were observed in *Eichhornia*, *Pistia* and *Ceratophyllum*. The first peak was observed in April in *Pistia*, and *Ceratophyllum* and the second in September. Sodium concentration was maxmium at maturity in *Trapa bispinosa* and after flowering the concentration declined considerably. In *Hydrilla* the sodium content was lesser than the surrounding water.

Nitrogen : The total nitrogen content increased as plants grew older as found in *Hydrilla*, *Nymphaea*, *Nelumbo* and *Ceratophyllum*. In *Nymphaea* and *Nelumbo* nitrogen increases along with growth and young plants were found to contain the minimum.

Discussion

In general the concentration of calcium in plants decreased from February to April in correspondence with the decrease of calcium in water. The calcium content of *Najas* however showed an opposite trend perhaps due to regeneration.

The seedlings and young plants of *Pistia*, *Trapa* and *Nymphaea* were found to show very little calcium and the concentration of calcium in-

TABLE 1

SHOWING SEASONAL CHANGE IN THE CHEMICAL COMPOSITION OF SOME AQUATIC PLANTS AND THE SURROUNDING WATER

Species	Month of collection	% of Ash	% of Silica	Total Nitrogen %	Calcium		Magnesium		Sodium		Potassium	
					Plant %	Water ppm.	Plant %	Water ppm.	Plant ppm.	Water ppm.	Plant ppm.	Water ppm.
Eichhornia crassipes	Feb. ..	17	2·2	2·45	7·48	44·5	6·7	44·0	125	45·5	500	21·0
	June ..	33	21·4	2·80	5·30	18·0	4·36	53·7	122	55·0	510	20·0
	July ..	28	8·2	..	4·76	28·0	4·14	42·5	128	55·0	900	33·0
	Sep. ..	2·6	18·0	..	4·92	47·0	1·09	25·0	125	37·5	860	18·0
	Nov. ..	8·0	..	..	6·50	..	4·69	..	118	..	460	..
Pistia stratiotes	Feb. ..	21·0	3·2	2·22	5·4	46·0	8·7	46·0	265	54	520	21·0
	April ..	20·2	8·0	5·07	4·92	48·0	3·7	55·0	265	58	440	25·0
	July ..	24·6	0·4	3·31	5·80	14·0	4·3	42·0	138	54	860	35·0
	Sept. ..	25·6	2·2	..	8·80	46·0	6·2	20·0	212	35	720	21·0
	Oct. ..	23·44	14·2	..	3·12	56·0	1·8	37·0	162	36	510	22·0
	Nov. ..	23·2	6·8	..	5·04	24·0	2·0	35·0	165	44	520	23·0
	Dec. ..	21·0	4·4	..	6·8	44·0	2·18	32·0	168	45	470	19·0
Najas minor	Feb. ..	26·0	2·4	3·58	12·0	44·8	8·95	44·0	118	45·5	690	21·0
	April ..	22·0	4·6	..	8·0	18·0	..	53·7	120	55·0	700	20·0
	July ..	27·8	5·0	3·82	3·78	28·0	4·36	42·5	122	55·0	1500	35·0
	Sept. ..	..	15·2	4·34	1·86	47·0	2·40	25·0	138	37·5	1400	18·0
Ceratophyllum demersum	Feb. ..	22	1·6	..	6·6	44·5	..	44·0	25	45·5	560	21·0
	Apr. ..	23	1·2	3·43	4·4	18·0	5·89	53·7	50	55·0	700	20·0
	June ..	16	7·4	3·97	8·0	28·0	..	42·5	43	25·0	550	33·0
	Sep. ..	18.8	9·2	2·94	1·8	47·0	1·74	25·0	53	37·5	1010	18·0
	Dec. ..	19.0	2·4	4·68	3·0	47·0	6·77	..	43	44·0	1020	20·0

Species	Month of collection	% of Ash	% of Silica	Total Nitrogen %	Calcium		Magnesium		Sodium		Potassium	
					Plant %	Water ppm.	Plant %	Water ppm.	Plant ppm.	Water ppm.	Plant ppm.	Water ppm.
Nelumbo nucifera	Feb. ..	15·6	6·0	5·07	3·2	44·5	2·62	44·0	122	45·5	700	21·0
	April ..	12·0	12·0	6·16	3·8	18·0	5·89	53·7	118	55·0	440	20·0
	June ..	36·0	17·0	4·75	3·4	28·0	..	..	87	55·0	540	33·0
Trapa bispinosa	Feb. ..	11·4	2·4	4·87	4·0	44·5	3·93	44·0	102	45·5	270	21·0
	April ..	18·2	2·0	3·15	5·18	48·0	2·62	55·0	102	58	270	25·0
	June ..	16·0	6·0	3·19	8·4	18·0	0·65	53·7	122	55·0	290	20·0
	Sep. ..	19·6	6·8	..	3·36	47·0	5·46	25·0	225	37·5	600	18·0
	Oct. ..	16·0	2·6	..	5·64	56·0	0·43	37·0	125	36·0	380	22·0
Hydrilla verticillata	Feb. ..	38·0	16·0	1·28	..	44·5	3·7	46·0	87	54·0	440	21·0
	April ..	15·2	10·4	..	5·56	48·0	4·36	55·0	65	58	425	25·0
	July ..	20·8	0·4	4·6	3·16	28·0	4·36	42·0	50	54	860	35·0
	Sep. ..	18·4	4·2	3·74	5·6	47·0	4·69	2·0	50	35	740	21·0
	Nov. ..	5·0	11·0	..	0·8	24·0	..	35·0	50	36	625	23·0
Nymphaea nouchali	Aug. ..	14·6	2·0	2·14	2·34	28·0	1·31	..	200	..	460	16·0
	Sep. ..	19·8	10·4	3·62	2·36	23·0	0·65	25·0	400	37·5	860	18·0
	Oct. ..	19·2	3·0	3·19	4·04	33·0	1·31	37·0	400	36·0	640	18·0
Spirodela polyrhiza	April ..	12·0	4·2	..	7·56	48·0	1·09	55·0	100	58	300	25
	June ..	40·0	20·0	4·75	..	23·0	..	53·7	90	75	510	42
	July ..	25·0	0·4	..	9·8	14·0	2·8	42·0	53	55	350	35
Potamogeton crasipus	Feb. ..	24·0	3·4	..	9·66	44·5	4·14	44·0	162	45·5	420	21·0
	April ..	2·0	0·2	1·20	4·70	48·0	..	55·0	160	58·0	500	25·0

creased later during growth. A decline was found at the time of flowering and fruiting. In terrestrial plants a decrease in concentration before leaf fall is quite common.

Potassium content was very low in the beginning as plants regenerated but at or before maturity this amount increased considerably. At the time of regeneration the ash content was found quite low. No correlation was found between the chemical contents of plants and the surrounding water.

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36. STUDIES IN CYPERACEAE IV. NOTES ON *SCLERIA RUGOSA* R. BR. AND ITS COMPLEX

(*With a plate*)

Among the specimens of Cyperaceae received for study from the Herbarium of the Forest Research Institute, Dehra Dun (DD), was an interesting specimen which can be identified as *Scleria rugosa* R. Br. This taxon in herbariums is usually mis-identified as *S. levis* Retz., *S. zeylanica* Poir., *S. thwaitesiana* Boeck. or *S. flaccida* Clarke. This confusion pertaining to the identity of all the concerned species within this complex is understandable partly in the light of the basic misinterpretation which is evident from the synonymies and the description given for *S. zeylanica* and *S. flaccida* and partly due to the fact that